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Kato

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- (54) **SOLID-STATE IMAGE SENSOR**
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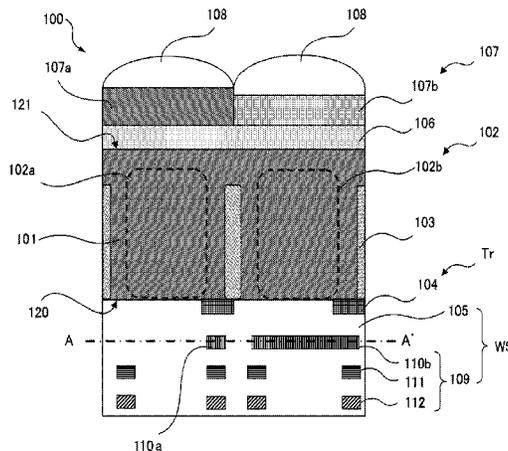
- (51) **Int. Cl.**
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- (52) **U.S. Cl.**
 CPC ... **H01L 27/14625** (2013.01); **H01L 27/14621**
 (2013.01); **H01L 27/14629** (2013.01)

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 See application file for complete search history.

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(57) **ABSTRACT**
 An image sensor includes a first pixel having a first color filter, a first reflection region which reflects light from the first color filter, and a first photoelectric conversion portion arranged in a semiconductor layer and located between the first color filter and the first reflection region, and a second pixel including a second color filter, a second reflection region which reflects light from the second color filter, and a second photoelectric conversion portion arranged in the semiconductor layer and located between the second color filter and the second reflection region. Wavelength corresponding to a maximum transmittance of the first color filter is shorter than wavelength corresponding to a maximum transmittance of the second color filter. An area of the first reflection region is smaller than area of the second reflection region.

15 Claims, 8 Drawing Sheets



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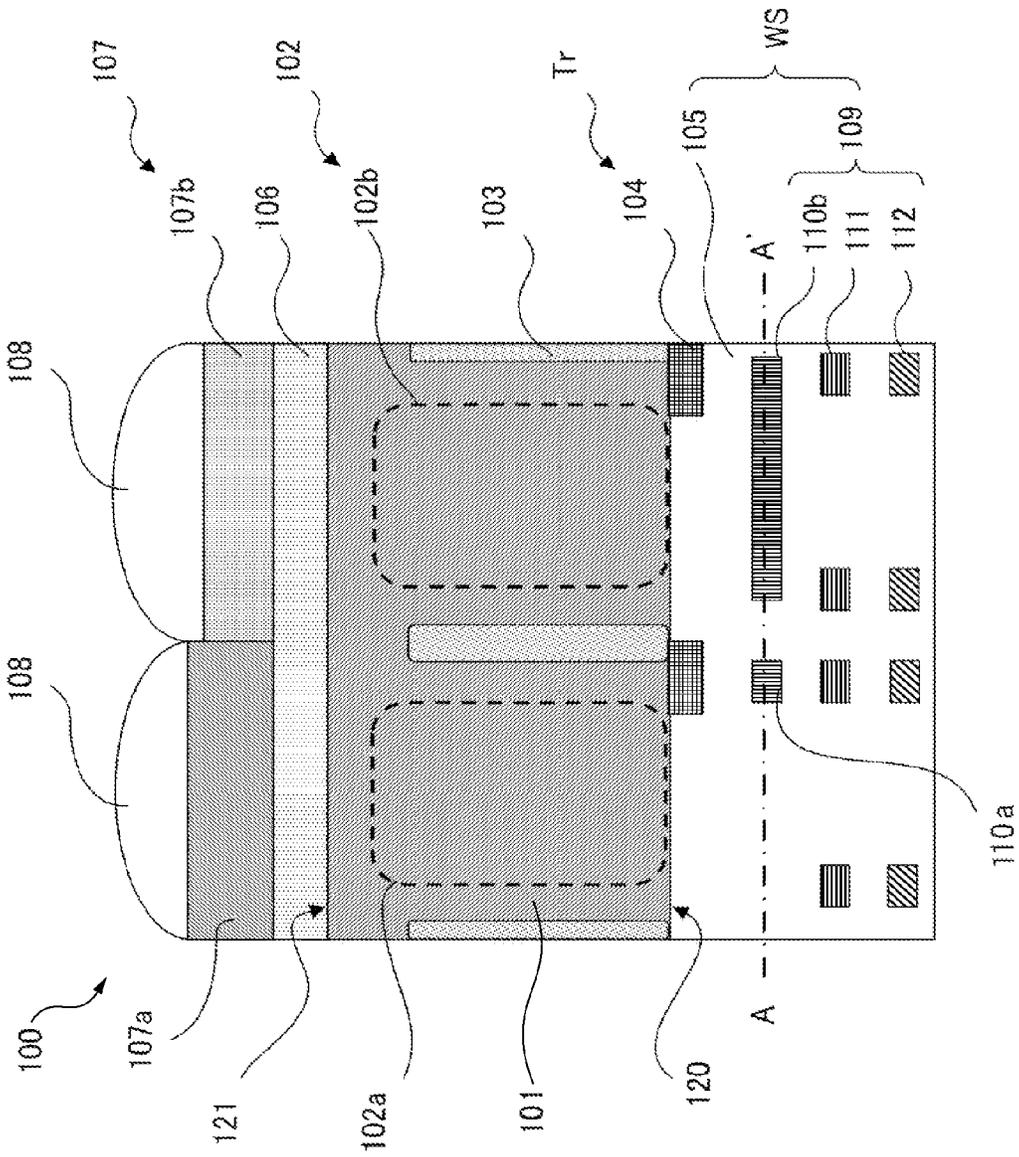
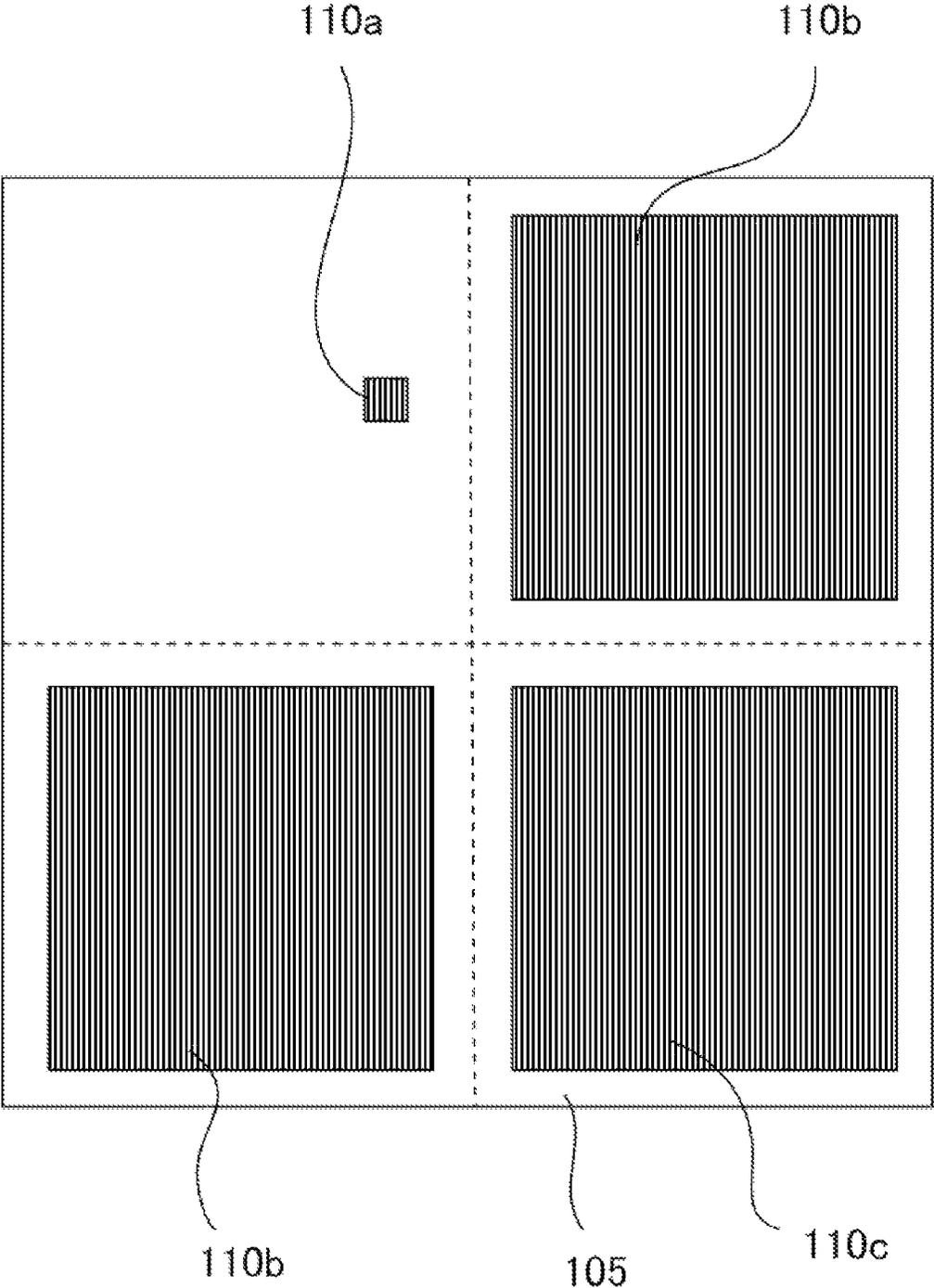


FIG. 1

FIG. 2



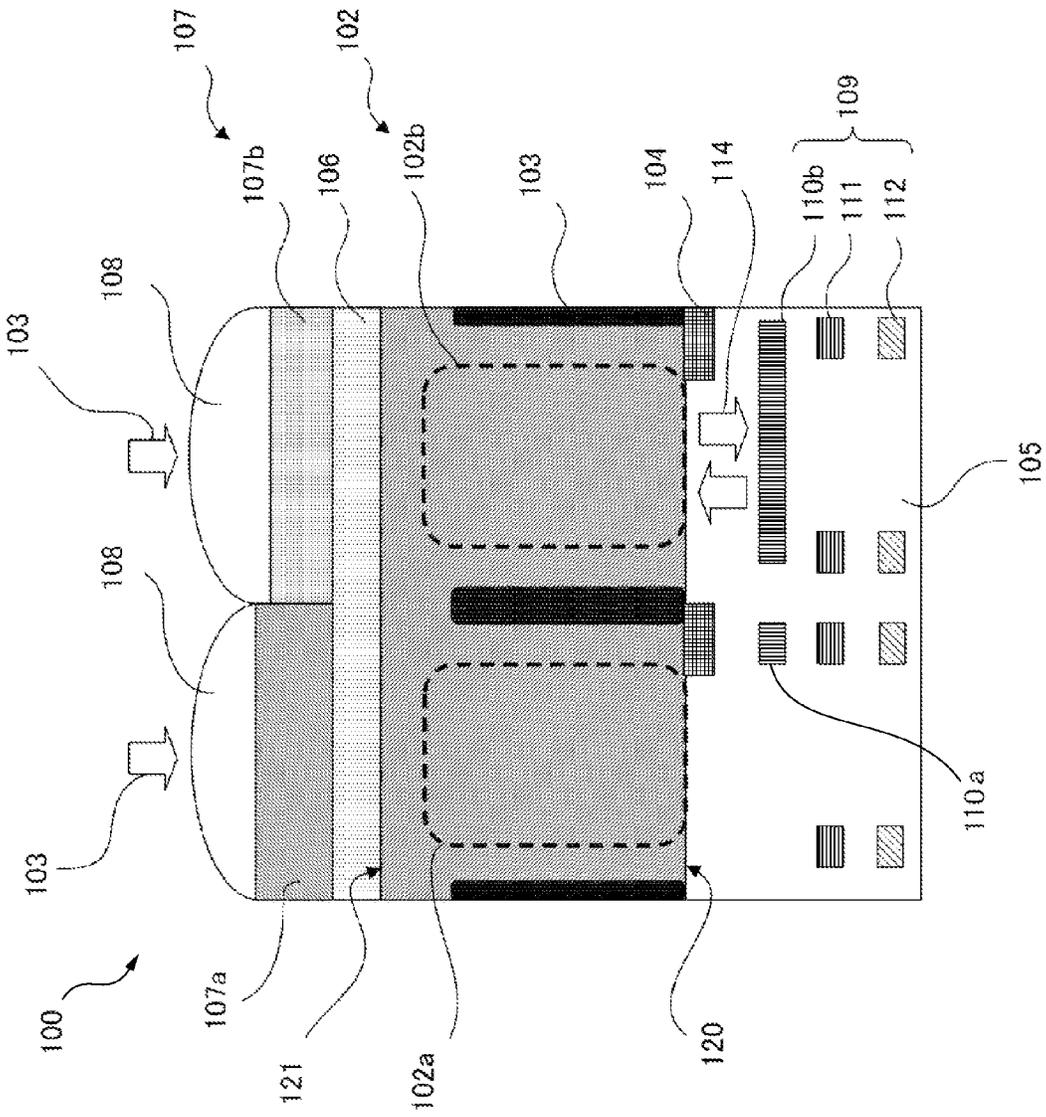


FIG. 3

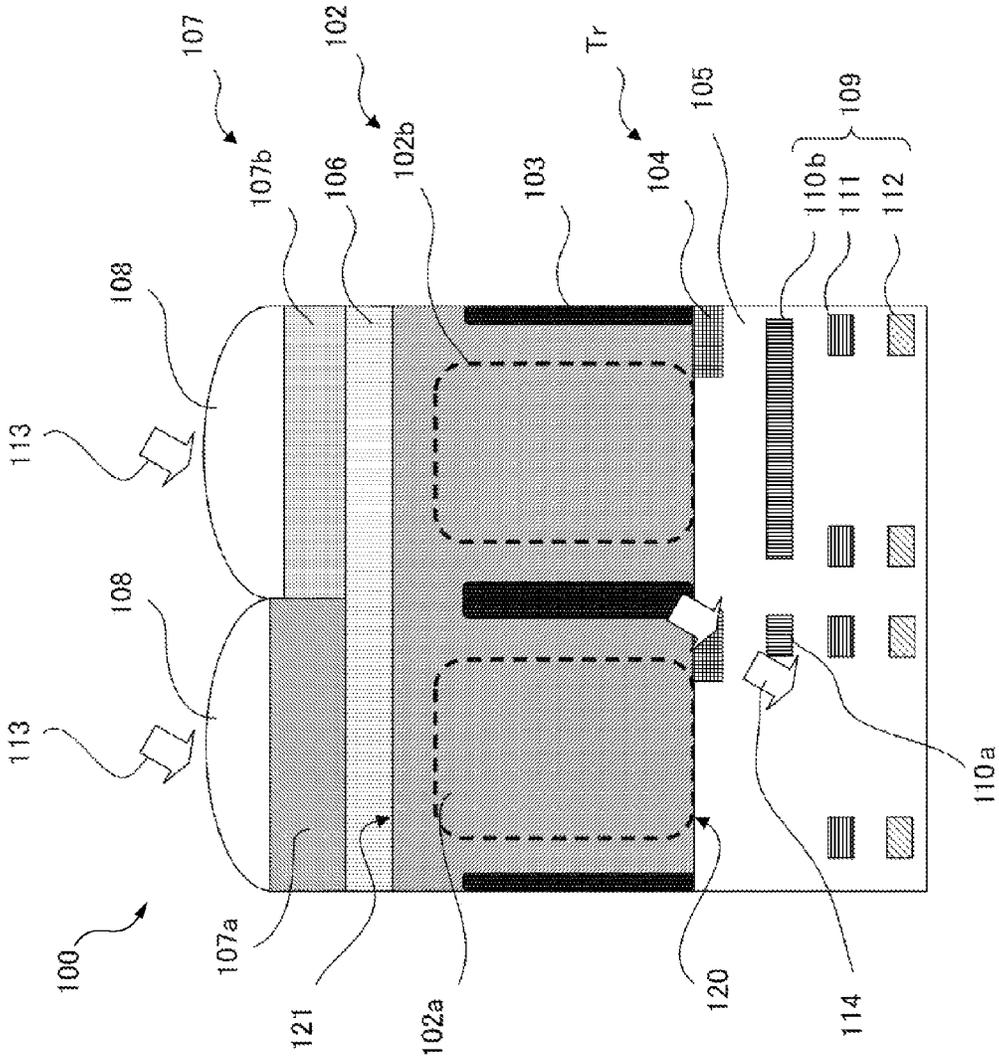
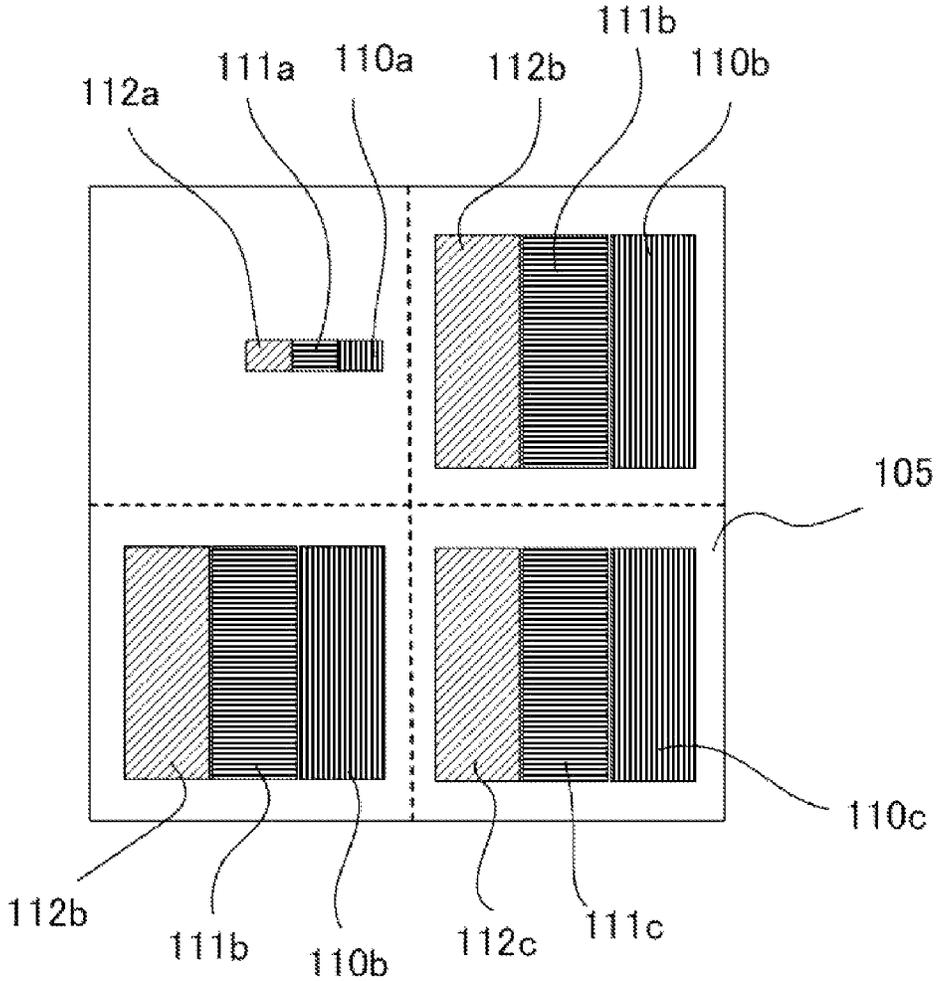


FIG. 4

FIG. 5B



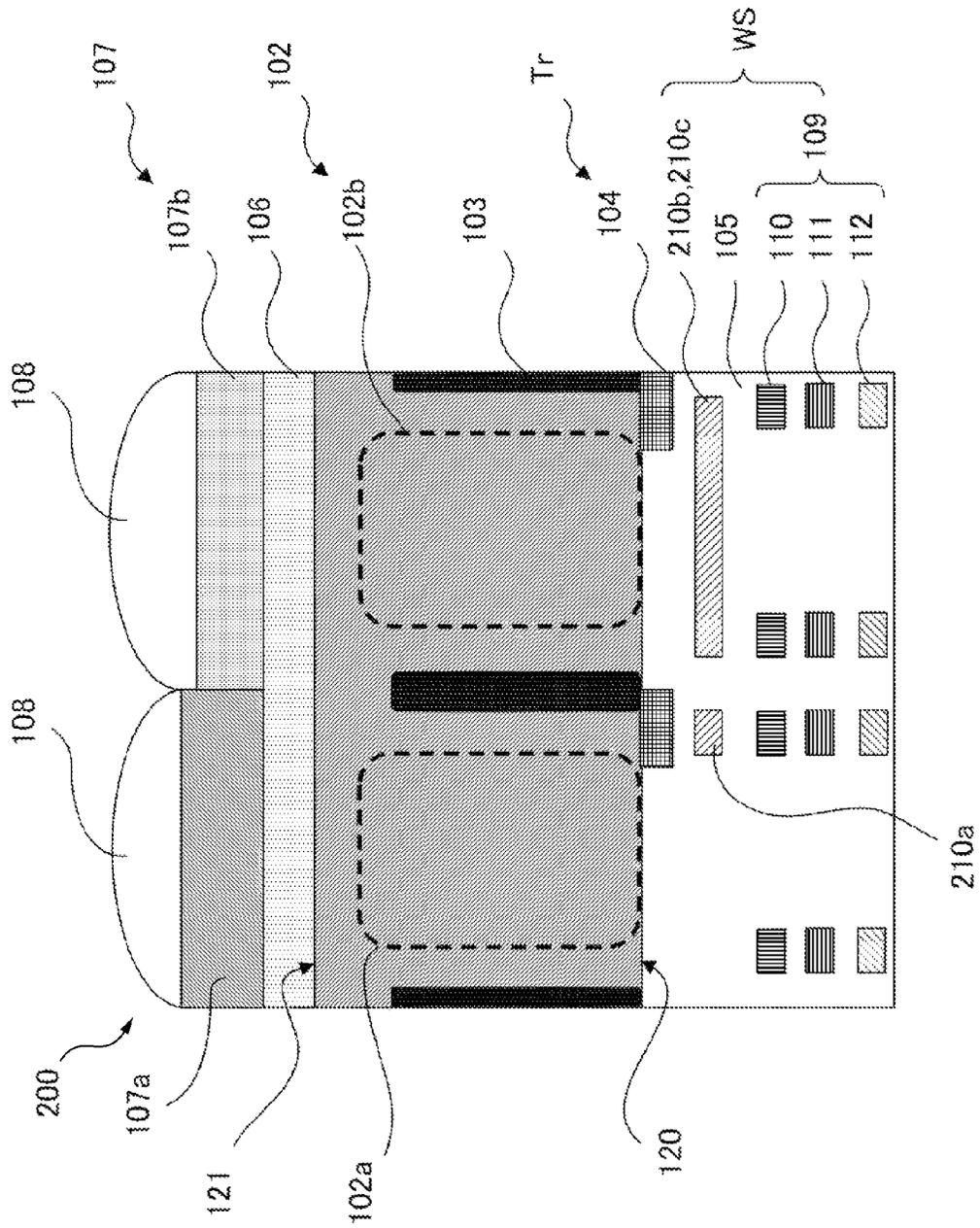
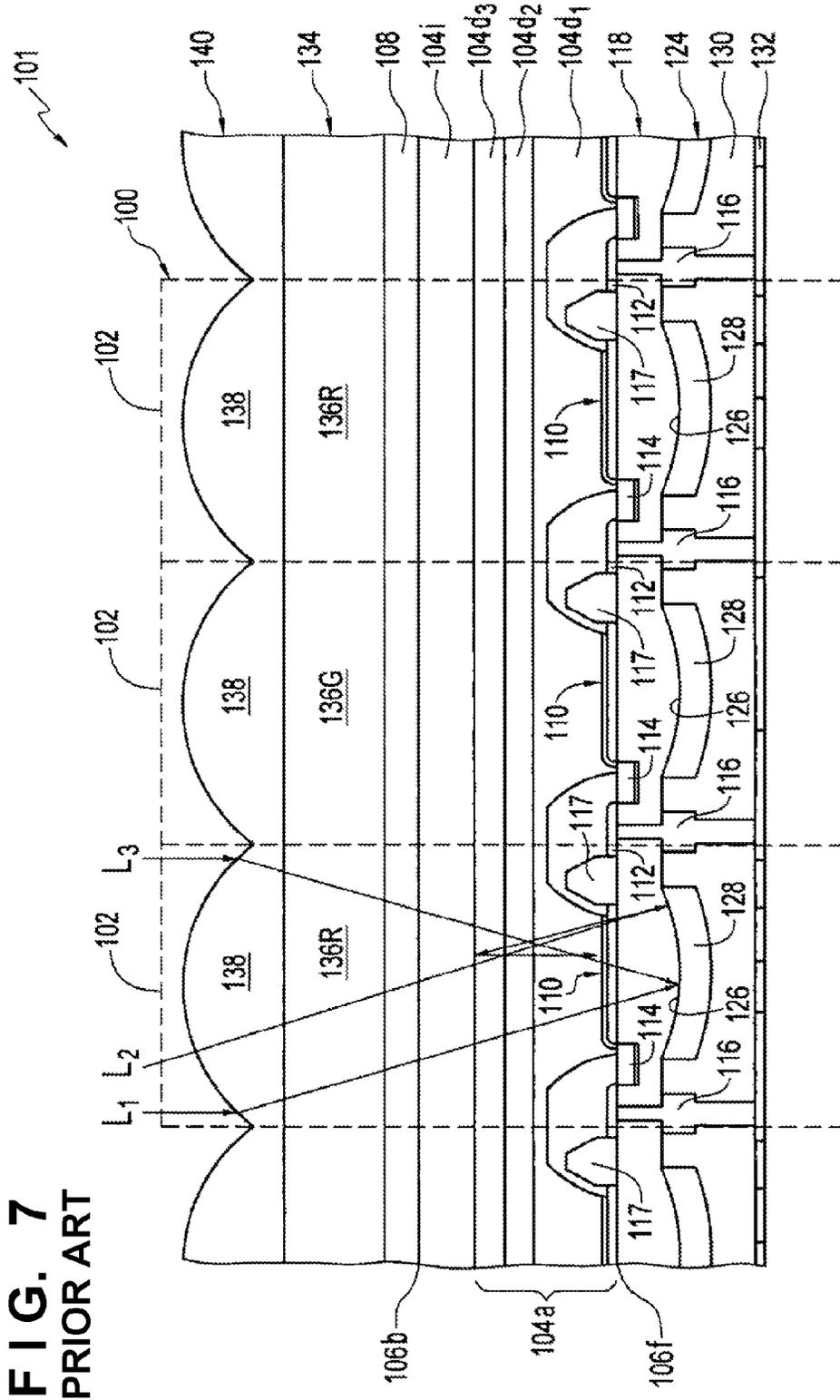


FIG. 6



US7,755,123

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SOLID-STATE IMAGE SENSOR

TECHNICAL FIELD

The present invention relates to a solid-state image sensor. 5

BACKGROUND ART

U.S. Pat. No. 7,755,123 describes a backside illuminated imaging device in which the thickness of a substrate is reduced to allow a photosensor to easily detect light incident on a back surface. FIG. 7 appended to this specification depicts a backside illuminated imaging device described in FIG. 1C of U.S. Pat. No. 7,755,123. The imaging device described in U.S. Pat. No. 7,755,123 includes a radiation reflector **128** that reflects photons, which are incident on and transmitted through a back surface of a semiconductor device substrate **104** or **104d1** to **104d3**, toward a photosensor formed in the semiconductor device substrate.

When radiation reflectors are respectively included in red, green, and blue pixels, for example, some light rays, which are obliquely incident on a color filter of the green pixel and are transmitted through the color filter, may be reflected by the radiation reflector of the blue pixel, and may be incident on the photosensor of the blue pixel. In this case, mixture of colors may occur between the green and blue pixels. Likewise, mixture of colors may occur between the green and blue pixels.

SUMMARY OF INVENTION

The present invention provides a technique advantageous to improve image quality.

One of the aspects of the present invention provides a solid-state image sensor including a semiconductor layer, the sensor comprising: a pixel of a first type including a first color filter, a first reflection region which reflects light transmitted through the first color filter, and a first photoelectric conversion portion arranged in the semiconductor layer, the first photoelectric conversion portion being located between the first color filter and the first reflection region; and a pixel of a second type including a second color filter, a second reflection region which reflects light transmitted through the second color filter, and a second photoelectric conversion portion arranged in the semiconductor layer, the second photoelectric conversion portion being located between the second color filter and the second reflection region, wherein a wavelength corresponding to a maximum transmittance of the first color filter is shorter than a wavelength corresponding to a maximum transmittance of the second color filter, and an area of the first reflection region is smaller than an area of the second reflection region.

Further features of the present invention will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a view illustrating the arrangement of a solid-state image sensor according to the first embodiment;

FIG. 2 is a view illustrating the arrangement of the solid-state image sensor according to the first embodiment;

FIG. 3 is a view illustrating the functions of the solid-state image sensor according to the first embodiment;

FIG. 4 is a view illustrating the functions of the solid-state image sensor according to the first embodiment;

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FIGS. 5A and 5B are views illustrating the arrangement of a modification of the first embodiment;

FIG. 6 is a view illustrating the arrangement of a solid-state image sensor according to the second embodiment; and

FIG. 7 is a view for explaining a solid-state imaging device described in U.S. Pat. No. 7,755,123.

DESCRIPTION OF EMBODIMENTS

A solid-state image sensor **100** according to the first embodiment of the present invention will be described below with reference to FIGS. 1 to 4 and FIGS. 5A and 5B. FIGS. 1, 3, and 4 are sectional views of the solid-state image sensor **100** taken along a plane perpendicular to its image sensing surface, and illustrate only two pixels for the sake of simplicity. Note that the image sensing surface is a surface on which a pixel array formed by arraying a plurality of pixels is arranged. FIG. 2 is a sectional view of the solid-state image sensor **100** taken along an A-A' plane in FIG. 1 as a plane parallel to its image sensing surface. The solid-state image sensor **100** can be configured as, for example, a MOS image sensor or CCD image sensor.

The solid-state image sensor **100** includes a semiconductor layer **101** having a first face **120** and second face **121**. The semiconductor layer **101** can be configured by, for example, a silicon substrate. The solid-state image sensor **100** further includes a wiring structure WS which is arranged on the side of the first face **120** of the semiconductor layer **101**, and a color filter layer **107** arranged on the side of the second face **121** of the semiconductor layer **101**. The color filter layer **107** can include a first color filter **107a**, second color filter **107b**, and third color filter **107c** (not shown). The arrangement of the first, second, and third color filters **107a**, **107b**, and **107c** can follow, for example, a Bayer matrix. A wavelength corresponding to a maximum transmittance of the first color filter **107a** is shorter than that corresponding to a maximum transmittance of the second color filter **107b**. The wavelength corresponding to the maximum transmittance of the first color filter **107a** is shorter than that corresponding to a maximum transmittance of the third color filter **107c**. Typically, the maximum value of a transmittance of a color filter can be decided within a visible light wavelength range of 380 to 810 nm.

The following description will be given under the assumption that the first color filter **107a** transmits light of a blue (B) wavelength range, the second color filter **107b** transmits light in a green (G) wavelength range, and the third color filter **107c** transmits light in a red (R) wavelength range. However, the present invention can also be achieved in an arrangement in which the first color filter **107a** transmits light of a blue (B) wavelength range, the second color filter **107b** transmits light in a red (R) wavelength range, and the third color filter **107c** transmits light in a green (G) wavelength range.

The solid-state image sensor **100** can further include a plurality of microlenses **108** arrayed on the color filter layer **107**. The solid-state image sensor **100** can further have a planarization layer **106** between the second face **121** of the semiconductor layer **101** and the color filter layer **107**. The planarization layer **106** can serve as, for example, an underlying film of the color filter layer **107**. At an image sensing timing, light is incident on photoelectric conversion portions **102** via the microlenses **108**. In this case, each microlens **108** is arranged on the side of the second face **121** of the semiconductor layer **101**, and the wiring structure WS is arranged on the side of the first face **120** of the semiconductor layer **101**. In this manner, the solid-state image sensor

which receives light from the side of the second face opposite to the side of the first face on which wiring structure is arranged can be called a backside illuminated solid-state image sensor.

A plurality of photoelectric conversion portions **102** are formed in the semiconductor layer **101**. The semiconductor layer **101** and each photoelectric conversion portion **102** are formed of impurity semiconductor regions of opposing conductivity types, and they form a p-n junction (photo-diode). The photoelectric conversion portion **102** is a region where carriers having the same polarity as that of charges to be read out as a signal are majority carriers. In the semiconductor layer **101**, an element isolation portion **103** which isolates the neighboring photoelectric conversion portions **102** from each other can be formed. The element isolation portion **103** can include an impurity semiconductor region having a conductivity type opposite to that of the photoelectric conversion portion **102** and/or an insulator. In this case, the insulator can be LOCOS isolation, STI isolation, or the like.

The solid-state image sensor **100** further includes a plurality of transistors Tr formed on the first face **120** of the semiconductor layer **101** so as to read out signals of the photoelectric conversion portions **102** or **102a**, **102b** and **102c**. Each transistor Tr includes a gate electrode **104** made up of, for example, polysilicon. In FIGS. **1**, **3**, and **4**, a source, drain, gate oxide film, and the like which form the transistor Tr are not shown. When the solid-state image sensor **100** is configured as a MOS image sensor, the plurality of transistors Tr can include, for example, transfer transistors required to transfer charges accumulated on the photoelectric conversion portions **102** to floating diffusions (not shown).

The wiring structure WS includes a stacked wiring portion **109** and interlayer insulation film **105**. The stacked wiring portion **109** can include, for example, a first wiring layer **110**, second wiring layer **111**, and third wiring layer **112**. The interlayer insulation film **105** can be formed of, for example, a silicon oxide film. In this embodiment, the first wiring layer **110** forms a reflection region that reflects light rays which are transmitted through the color filters **107a**, **107b**, and **107c**, are incident on the photoelectric conversion portions **102**, and are transmitted through the photoelectric conversion portions **102**. The first wiring layer **110** can include a first reflection region **110a**, second reflection region **110b**, and third reflection region **110c**, as exemplified in FIG. **2**.

The first wiring layer **110**, second wiring layer **111**, and third wiring layer **112** as the stacked wiring portion **109** can contain, for example, one of aluminum, copper, gold, tungsten, titanium, and tantalum as a major component. Alternatively, the first reflection region **110a**, second reflection region **110b**, and third reflection region **110c** can be formed by a member containing, for example, one of aluminum, copper, gold, tungsten, titanium, and tantalum as a major component.

The solid-state image sensor **100** includes a pixel array configured by arraying a plurality of pixels. The plurality of pixels include at least pixels of a first type and those of a second type, and typically include pixels of a first type, those of a second type, and those of a third type. In one example, the pixel of the first type can include the first color filter **107a**, first photoelectric conversion portion **102a**, and first reflection region **110a**. The first reflection region **110a** reflects light rays, which are transmitted through the first color filter **107a**, are incident on the first photoelectric conversion portion **102a**, and are transmitted through the

first photoelectric conversion portion **102a**, toward the first photoelectric conversion portion **102a**. The pixel of the second type can include the second color filter **107b**, second photoelectric conversion portion **102b**, and second reflection region **110b**. The second reflection region **110b** reflects light rays, which are transmitted through the second color filter **107b**, are incident on the second photoelectric conversion portion **102b**, and are transmitted through the second photoelectric conversion portion **102b**, toward the second photoelectric conversion portion **102b**. The pixel of the third type can include the third color filter **107c**, third photoelectric conversion portion **102c**, and third reflection region **110c**. The third reflection region **110c** reflects light rays, which are transmitted through the third color filter **107c**, are incident on the third photoelectric conversion portion **102c**, and are transmitted through the third photoelectric conversion portion **102c**, toward the third photoelectric conversion portion **102c**. The area of the first reflection region **110a** is smaller than that of the second reflection region **110b**. Also, the area of the first reflection region **110a** is smaller than that of the third reflection region **110c**.

Absorption of light by the semiconductor layer **101** and effects obtained when the reflection regions **110a**, **110b**, and **110c** are arranged will be described below under the assumption that the thickness of the semiconductor layer **101** is 3 μm , so as to provide a practical example. A ratio of absorption of light, which is incident on the second face **121**, by the semiconductor region between the second face **121** and first face **120** (a ratio to light incident on the second face **121**) is different depending on wavelengths of light. A case will be examined below wherein light is perpendicularly incident on the second face **121**. In this case, until light passed through the second face **121** reaches the first face **120**, about 87.2% of light rays of a wavelength of 550 nm, which are transmitted through the green color filter **107b**, is absorbed, and about 70.3% of light rays of a wavelength of 620 nm, which are transmitted through the red color filter **107c**, is absorbed. At this time, as illustrated in FIG. **3**, light rays **114**, which are not absorbed, are reflected by the first wiring layer **110** including the reflection regions **110a**, **110b**, and **110c**, are returned to the photoelectric conversion portions **102**, and are absorbed by the photoelectric conversion portions **102**. Hence, by arranging the reflection regions **110a**, **110b**, and **110c**, the sensitivity can be improved.

On the other hand, 99.9% of light rays **113** of a wavelength of 450 nm, which are transmitted through the blue color filter **107a**, is absorbed after they travel from the second face **121** before they reach the first face **120**. That is, most of the light rays **113** of the wavelength of 450 nm are photoelectrically converted by the photoelectric conversion portion **102** before they reach the first face **120**. For this reason, the reflection region **110a** arranged on the side of the first face **120** of the blue pixel (pixel of the first type) has nearly no influence on the sensitivity if its area is smaller than those of the reflection regions **110b** and **110c** which are arranged on the side of the first face **120** of the green and red pixels. Rather, the light rays **114** of green and red regions, which are transmitted through the photoelectric conversion portions **102** of surrounding pixels, can be incident on the first reflection region **110a** included in the blue pixel (pixel of the first type), as illustrated in FIG. **4**. Such light rays **114** can be reflected by the first reflection region **110a** included in the blue pixel (pixel of the first type), and can be incident on the first photoelectric conversion portion **102a** of the blue pixel. Thus, mixture of colors occurs since signals of pixels of other colors are mixed in a signal of the blue pixel.

Therefore, since the area of the first reflection region **110a** of the blue pixel (pixel of the first type) is set to be smaller than those of the second and third reflection regions **110b** and **110c**, improvement of the sensitivity and reduction of mixture of colors can be realized. In this case, by only setting the area of the first reflection region **110a** of the blue pixel (pixel of the first type) to be smaller than that of one of the second and third reflection regions **110b** and **110c**, the effects of improvement of the sensitivity and reduction of mixture of colors can be obtained.

In the first embodiment, since the reflection regions **110a**, **110b**, and **110c** are formed by the wiring layer **110**, another layer need not be added, thus suppressing the manufacturing processes from being complicated. In the first embodiment, the reflection regions **110a**, **110b**, and **110c** are formed by the wiring layer closest to the first face **120** of the semiconductor layer **101** of the plurality of wiring layers **110**, **111**, and **112**. Thus, the distances between the reflection regions **110a**, **110b**, and **110c** and photoelectric conversion portions **102** can be shortened, and stray light can be reduced. As a result, the sensitivity can be improved, and mixture of colors can be reduced.

In the first embodiment, the reflection regions **110a**, **110b**, and **110c** are formed by the wiring layer closest to the first face **120** of the semiconductor layer **101** of the plurality of wiring layers **110**, **111**, and **112**. However, the reflection regions **110a**, **110b**, and **110c** may be formed by another wiring layer **111** or **112** or by two or more out of the plurality of wiring layers **110**, **111**, and **112**. The area of the reflection region can be evaluated as that of a portion projected onto the first face **120** when a portion which functions as the reflection region is projected onto the first face **120**. FIGS. **5A** and **5B** exemplify a case in which the reflection regions **110a**, **110b**, and **110c** are formed by the first wiring layer **110**, reflection regions **111a**, **111b**, and **111c** are formed by the second wiring layer **111**, and reflection regions **112a**, **112b**, and **112c** are formed by the third wiring layer **112**. FIG. **5B** shows portions, which function as reflection regions, and are projected onto the first face **120**. The pixel of the first type includes the first reflection regions **110a**, **111a**, and **112a**, that of the second type includes the second reflection regions **110b**, **111b**, and **112b**, and that of the third type includes the third reflection regions **110c**, **111c**, and **112c**. With this arrangement, since the area of the first wiring layer **110** used to form the reflection regions **110a**, **110b**, and **110c** can be reduced, a parasitic capacitance between the first wiring layer **110** and semiconductor layer **101** can be small, thus reducing noise components.

In the above practical example, the thickness of the semiconductor layer **101** is 3 μm . However, the thickness of the semiconductor layer **101** can be, for example, 2 μm or more. When the thickness of the semiconductor layer **101** is 2 μm or more, 99.0% or more light rays of the wavelength of 450 nm, which are transmitted through the blue color filter **107a**, is absorbed after they travel from the second face **121** before they reach the first face **120**. Hence, most of these light rays of the wavelength of 450 nm, which are transmitted through the blue color filter **107a**, are photoelectrically converted by the photoelectric conversion portion **102** before they reach the first face **120**. For this reason, the reflection region **110a** formed on the side of the first face **120** of the blue pixel (pixel of the first type) has nearly no influence on the sensitivity if it is smaller than the reflection regions **110b** and **110c** formed on the side of the first face **120** of the green and red pixels.

The reflection regions **110a**, **110b**, and **110c** can have a concave surface shape, so as to condense light on the corresponding photoelectric conversion portions **102**.

By setting focus positions of the microlenses **108** between the first face **120** and the reflection regions **110a**, **110b**, and **110c**, spreads of light rays reflected by the reflection regions **110a**, **110b**, and **110c** can be suppressed. Thus, a returning ratio of light reflected by the reflection regions **110a**, **110b**, and **110c** to the photoelectric conversion portions **102** can be increased, thus improving the sensitivity.

A solid-state image sensor **200** according to the second embodiment of the present invention will be described below with reference to FIG. **6**. Items which are not mentioned in this embodiment can follow the first embodiment. In the solid-state image sensor **200** of the second embodiment, reflection regions **210a**, **210b**, and **210c** are arranged at positions different from the stacked wiring portion **109**. Note that the reflection regions **210a**, **210b**, and **210c** reflect light rays, which are transmitted through the color filters **107**, are incident on the photoelectric conversion portions **102**, and are transmitted through the photoelectric conversion portions **102**, toward the photoelectric conversion portions **102** as in the aforementioned reflection regions **110a**, **110b**, and **110c**. The first reflection region **210a** is included in a pixel of the first type having the first color filter **107a**. The second reflection region **210b** is included in a pixel of the second type having the second color filter **107b**. The third reflection region **210c** is included in a pixel of the third type having the third color filter **107c**. When a member having the reflection regions **210a**, **210b**, and **210c** is made of a conductive material such as a metal, that member can have a fixed potential applied thereto or can be maintained in a floating state.

The reflection regions **210a**, **210b**, and **210c** can be formed by a member which contains one of aluminum, copper, gold, tungsten, titanium, and tantalum as a major component. Alternatively, the reflection regions **210a**, **210b**, and **210c** may be formed by a dielectric multilayer film. The area of the first reflection region **210a** is smaller than that of the second reflection region **210b**. Also, the area of the first reflection region **210a** is smaller than that of the third reflection region **210c**.

In the second embodiment, since the reflection regions **210a**, **210b**, and **210c** are arranged at positions different from the stacked wiring portion **109**, a process for forming the reflection regions **210a**, **210b**, and **210c** has to be added. However, compared to the configuration which uses the stacked wiring portion **109** formed for the purpose of wiring also as reflection regions, degrees of freedom in arrangement of the reflection regions **210a**, **210b**, and **210c** are high, and the reflection regions **210a**, **210b**, and **210c** can be arranged at positions closer to the first face **120**. Thus, stray light can be reduced. As a result, the sensitivity can be improved, and mixture of colors can be reduced. Also, compared to the configuration which uses the stacked wiring portion **109** formed for the purpose of wiring also as reflection regions, since the reflection regions **210a**, **210b**, and **210c** have higher degrees of freedom in selection of materials required to form them, materials having higher reflectances than aluminum and copper can be used. Thus, the sensitivity can be improved. In addition, compared to the configuration which uses the stacked wiring portion **109** formed for the purpose of wiring also as reflection regions, the reflection regions **210a**, **210b**, and **210c** have higher degrees of freedom in shape. For example, a concave surface shape for condensing light on the photoelectric conversion portion can be adopted. Thus, the sensitivity can be improved.

In the second embodiment, all of pixels of the first, second, and third types have the reflection regions formed of the member different from the stacked wiring portion 109. However, in the present invention, some of the pixels of the first, second, and third types may have the reflection regions formed by the member different from the stacked wiring portion 109, and the remaining pixels may have the reflection regions formed by the stacked wiring portion 109. For example, the reflection regions of blue and green pixels can be formed by the first wiring layer 110, and those of red pixels can be arranged at positions between the first face 120 and first wiring layer 110. This arrangement is advantageous to set the reflectance of the reflection regions of the red pixels to be higher than those of the reflection regions of the blue and green pixels and to improve the sensitivity of the red pixels. Alternatively, the reflection regions of blue pixels can be formed by the first wiring layer 110, and those of green and red pixels can be arranged at positions between the first face 120 and first wiring layer 110. This arrangement is advantageous to set the reflectance of the reflection regions of the green and red pixels to be higher than that of the reflection regions of the blue pixels and to improve the sensitivity of the green and red pixels.

The formation positions of the reflection regions 210a, 210b, and 210c are not limited to those between the semiconductor layer 101 and stacked wiring portion 109. For example, the reflection regions 210a, 210b, and 210c may be formed between the wiring layers 110, 111, and 112 in the stacked wiring portion 109. The reflection regions 210a, 210b, and 210c may be arranged at positions according to the pixels of the first, second, and third types (that is, at positions according to wavelength ranges of light rays to be reflected). Thus, the sensitivities of the pixels of the first, second, and third types can be individually improved.

While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

This application claims the benefit of Japanese Patent Application No. 2011-191072, filed Sep. 1, 2011, which is hereby incorporated by reference herein in its entirety.

The invention claimed is:

1. A solid-state image sensor including a semiconductor layer and a wiring structure, wherein the semiconductor layer is a silicon substrate having a thickness not less than 2 μm , the sensor comprising:

a pixel of a first type including a first color filter, a first member included in one wiring layer of the wiring structure, and a first photoelectric conversion portion arranged in the semiconductor layer, the first photoelectric conversion portion being located between the first color filter and the first member; and

a pixel of a second type including a second color filter, a second member included in one wiring layer of the wiring structure, the second member having a reflection region which reflects light transmitted through the semiconductor layer, and a second photoelectric conversion portion arranged in the semiconductor layer, the second photoelectric conversion portion being located between the second color filter and the second member,

wherein the semiconductor layer has a first face and a second face, the first member and the second member

are arranged on a side of the first face, the first color filter and the second color filter are arranged on a side of the second face,

wherein the wiring structure includes an insulation film disposed between the one wiring layer and the semiconductor layer, and an electrode of polysilicon is arranged between the insulation film and the semiconductor layer,

wherein a wavelength corresponding to a maximum transmittance of the first color filter is in a blue wavelength range and is shorter than a wavelength corresponding to a maximum transmittance of the second color filter,

wherein an area of the first member projected onto the first face of the semiconductor layer is smaller than an area of the second member projected onto the first face, and wherein the electrode and the first member are both arranged on a single axis perpendicular to the first face.

2. The sensor according to claim 1, wherein the pixel of the first type further includes a first transistor configured to read out a signal of the first photoelectric conversion portion, wherein the pixel of the second type further includes a second transistor to read out a signal of the second photoelectric conversion portion, and wherein the electrode is a gate electrode of the first transistor.

3. The sensor according to claim 1, wherein a gate electrode of the second transistor and the second member are both arranged on a single axis perpendicular to the first face.

4. The sensor according to claim 1, wherein the first member is positioned between the electrode and another wiring layer of the wiring structure in a direction perpendicular to the first face.

5. The sensor according to claim 1, wherein the one wiring layer including the first member and the second member is arranged between the semiconductor layer and a plurality of wiring layers of the wiring structure.

6. The sensor according to claim 1, further comprising: a pixel of a third type including a third color filter, third member included in one wiring layer of the wiring structure, and a third photoelectric conversion portion arranged in the semiconductor layer, the third photoelectric conversion portion being located between the third color filter and the third member,

wherein the wavelength corresponding to the maximum transmittance of the second color filter is shorter than a wavelength corresponding to a maximum transmittance of the third color filter, and

wherein the area of the second member projected onto the first face is not smaller than an area of the third member projected onto the first face.

7. The sensor according to claim 1, wherein the first member and the second member contain one of aluminum, copper, gold, tungsten, titanium, and tantalum as a major component.

8. The sensor according to claim 1, wherein 99.0% or more of light rays which are transmitted through the first color filter is absorbed by the semiconductor layer before the light rays reach the first face.

9. The sensor according to claim 1, wherein an insulator is arranged between the first photoelectric conversion portion and the second photoelectric conversion portion.

10. The sensor according to claim 1, wherein the pixel of the first type further includes a first microlens arranged on the side of the second face,

wherein the pixel of the second type further includes a second microlens arranged on the side of the second face, and

wherein a focus position of the second microlens being set between the first face and the reflection region of the second member.

11. The sensor according to claim 1, wherein the wavelength corresponding to the maximum transmittance of the second color filter is in a green wavelength range. 5

12. The sensor according to claim 6, the area of the first member projected onto the first face is smaller than an area of the third member projected onto the first face.

13. The sensor according to claim 1, wherein the reflection region of the second member has a concave surface. 10

14. The sensor according to claim 1, wherein the first member and the second member applied with a fixed potential.

15. The sensor according to claim 1, wherein an entire area of the first member projected onto the first face is included in an area of the electrode projected onto the first face. 15

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